ANALYSIS OF PREPAREDNESS TOWARDS ADOPTING CLOUD COMPUTING TECHNOLOGY: A CASE OF KENYA MEDICAL RESEARCH INSTITUTE/CENTRES FOR DISEASE CONTROL AT THE KISIAN STATION, KISUMU COUNTY, KENYA

BY

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DECLARATION

This research project is my original work and has not been submitted for an award of any degree or an academic qualification in any other Institution or University.

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This research project is dedicated to my Mum Elizabeth Ogogo, Dad Chris Ogogo and Sisters Eddah, Julliet, Sheilah and Hazel.

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LIST OF ABBREVIATIONS AND ACRONYMS

BPAAS	Business Process as a Service
CAPEX	Capital Expenditure
CCs	Cloud Consumers
CDC	Centers for Disease Control and Prevention
CGHR	Centres for Global Health & Research
CI	Confidence Interval
CPs	Cloud Providers
HDSS	Health and Demographic Surveillance System
IAAS	Infrastructure as a Service
ICT	Information & Communications Technology
IT	Information Technology
KEMRI	Kenya Medical Research Institute
MOH	Ministry of Health
NIST	National Institute of Standards and Technology
OPEX	Operational expenditure
OR	Odds Ratios
PAAS	Platform as a Service
SAAS	Software as a Service
SAS	Statistical Analysis System
SMEs	Small and Medium-sized Enterprises
TAM	Technology Acceptance Model

ABSTRACT

Cloud computing is a new term in the computing world and it signals the advent of a new computing paradigm. Adopting cloud computing as an organization wide strategy requires careful planning, creation of roadmap and phased execution. KEMRI/CDC is currently struggling with massive volumes of paperwork stored in huge filing safes and occupying rooms and a lot of space. The purpose of this study was to do an analysis of preparedness towards adopting cloud computing technology at the Kenya Medical Research Institute/Centres for Disease Control at the Kisian Station, Kisumu County, Kenya. The objectives of the study were: to establish the extent to which infrastructure as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC, to assess how staff knowledge as a component of preparedness would influence the adoption of cloud computing in KEMRI/CDC, to examine the extent to which staff skills as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC and to examine the extent to which staff attitude as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC. The findings of this study would help organizations on the verge of adopting cloud computing, to better understand the underlying factors that need to be considered for it to be successful. This study was informed by the technology Acceptance Model. A descriptive survey study design was employed in implementing the study. The target population was all KEMRI/CDC staff stationed at CGHR campus in Kisian. A sample size of 305 was used from a target population of 1300 staff. 305 questionnaires were administered and 300 (98.4%) returned for analysis. Proportional sampling method was adopted during data collection in the different department. Structured questionnaire were used to collect the required data. Pilot testing of the data collection tool was done before the actual data collection process to validate the tool. Data collected were coded, scanned using Teleforms software and extracted into Ms Access to create the database. Data was then cleaned and analyzed using SAS and the results presented in tables. Descriptive and inferential statistical analysis was used to come up with associations between the variables (Chi Square), Odds Ratios and frequency distribution regarding preparedness towards adoption of cloud computing. The study showed that: majority of projects stored their data in network drives 237(79%), a good indication that KEMRI/CDC has servers with capabilities of storing large amounts of data. It established that there was an association between field of specialization and knowledge of cloud computing (chi=87.13, $p<0.001$) and that those who knew cloud computing were nearly 14 times more likely to be prepared to adopt cloud computing (OR=14.52, 95% CI [7.91, 26.64], $p<0.001$). The study found that there was a significant association between age and the thought that KEMRI/CDC was prepared to adopt cloud computing (chi=13.34, $p=0.04$). This study recommends upgrading the internet bandwidth from the service provider in order to efficiently handle cloud computing and that basic trainings on ICT processes to staff and regular awareness training on new technologies to be introduced in KEMRI/CDC to be able to empower all staff in all cadres and ages to appreciate the advent of new technologies.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

National Institute of Standards and Technology (NIST) , defines Cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Grance & Mell, 2011). Cloud technology tries to disguise complexity for its clients. Generally, Cloud providers use virtualization technologies combined with self-service abilities for computing resources via network infrastructure especially the Internet (Sabahi, 2011).

The European Network and Information Security Agency (ENISA) defines cloud computing as "on-demand service model for IT provision, often based on virtualization and distributed computing technologies" (Catteddu & Hogben, 2009). However, the first academic definition of cloud computing was offered by Ramnath Chellapa in 1997 where he defined the term cloud as "a computing paradigm where the boundaries of computing will be determined rationale rather than technical" (Chellapa, 1997).

Cloud computing is a new term in the computing world (Luis et al., 2008, Buyya et al.,2008) and it signals the advent of a new computing paradigm (Luis et al., 2008). This new paradigm is quickly developing and attracts a number of customers and vendors alike. The quick development of cloud computing is being fuelled by the emerging computing

technologies which allows for reasonably priced use of computing infrastructures and mass storage capabilities. It also removes the need for heavy upfront investment in Information Technology (IT) infrastructure. Cloud computing is a computing paradigm that involves outsourcing of computing resources with the capabilities of expendable resource scalability, on-demand provisioning with little or no up-front IT infrastructure investment costs (Catteddu and Hogben, 2009, Chow et al., 2009, GNi, 2009, Jeffrey and Neidecker-Lutz,2009). Adopting cloud computing as an organization wide strategy requires careful planning, roadmap creation and phased execution.

Cloud computing offers massively scalable, elastic resources; for example data, computing power and services over the internet from remote data centres to the consumers. The growing market penetration, with an ever more diverse provider and service landscape, turns cloud computing marketplaces a highly competitive one. In this highly competitive and distributed service environment, the assurances are insufficient for the consumers to identify the dependable and trustworthy Cloud providers.

Globally, the majority of organizations are at the stage of "investigating the technology," with only a very small number (3 %) having rejected the move to cloud outright. The adoption and level of engagement around cloud points to the fact that organizations needs and IT environments across the world are as unique as ever, leading to a staggered uptake of cloud models. Overall, there is healthy uptake of cloud solutions. 37% of businesses globally are deploying cloud to either remotely host applications or host data (or both), with North America and Asia being most advanced in their implementation of cloud solutions (AMD, 2011).

The Government of UK is committed to reducing waste and delivering modern public services at a lower cost. It already saved hundreds of millions of pounds in 2010/11 by stopping or reducing amount spent on 'low value' ICT projects. The Government ICT Strategy, published in March 2011, describes a longer term program of reform to improve Government ICT and deliver greater savings. This Strategic Implementation Plan provides a reference for central government and even non- Governmental organizations. Key to this strategy is the implementation of Cloud computing Technology, which will make available the government resources to the public over the internet and which will enable re-use of business applications and components across the public sector by creation of a fully operational online Application Store.

According to Gartner, Forrester, and other leading industry and research organizations, the worldwide market of cloud computing users is expected to skyrocket. Indeed, Gartner predicts that the market will rise from $58 billion in 2009 to $150 billion in 2013 (Gartner, 2010) and Forrester predicts that the market for cloud computing is going to increase from about $41 billion in 2010 to $241 billion in 2020 (O'Neill, 2011). Several other studies lend credibility to the prediction that cloud computing is here to stay and will see tremendous growth.

In Canada a study by Microsoft noted that a number of organizations are unclear about their own adoption of cloud technologies. The study states that 19% of Canadian businesses who thought they weren't using cloud services actually were leveraging cloud computing solutions (Microsoft, 2011). Gartner continues to explain that, cloud computing, with its exceptional 25 % growth rate, represented over USD 56 billion in 2009 and should account for USD 150 billion in 2013 (some 10 % of worldwide investment in the IT sphere).

The same source reports that, in 2010, cloud computing took the lead position in terms of investment, ahead of Green-IT and virtualization.

In France, the consultancy firm Markess estimated, during the Eurocloud Congress in April 2010, that the French cloud computing market represented EUR 1.5 billion in 2009 and was expected to grow to EUR 2.3billion by 2011. A prerequisite for companies' successful adoption of cloud computing, with all its many benefits, is a prior understanding of this new phenomenon in IT services. In many cases, specific expertise has to be developed in the fields of data-centre administration and commercial relations before implementing the cloud concept.

In England, recommendations were made by the Congress of the Liberal Democrat Party to the British Government in September 2011, concerning the adoption of cloud computing:

> "We have noted the growing popularity of cloud computing. It is clear that this new technology provides tremendous opportunities to streamline the use of IT, reducing costs and driving up efficiency. However, cloud computing is an area where, if left unchecked, there is serious potential for abuse. Cloud Computing is only attractive if it embodies the principles on privacy and data ownership, access, project management and procurement. We recommend that as a matter of urgency, the government consider the security issues involved with cloud computing, particularly regarding data location and segregation." Report of the Congress of the Liberal Democratic Party (England), September 2011.

In Africa, ITU/BDT organized the 12th Forum on Telecommunication/ICT Regulation and Partnership in Africa (FTRA 2011), held in Kigali (Republic of Rwanda) from 13 to 15 June 2011 under the theme "Cloud computing, development prospects of ICTs: Challenges and opportunities for policymakers, regulators and ICT operators" (FTRA 2011).The forum served as an opportunity for participants to raise questions concerning the development of cloud computing in Africa. Those questions related mainly to: Data security and Cost effectiveness due:- to lack of unnecessary expensive computer or protected storage system, lack of IT maintenance costs, lack of expensive software and due to the fact that cloud computing works via the Web, with access to services by means of a simple browser and, increasingly, with free operating systems. However, other key prerequisites for cloud computing were identified: Good Internet connectivity, a sound software and hardware market, applications need to be virtualized, trust in the security of the systems used, access, privacy, reliability and compliance in cloud computing, liability and regulation in regard to cloud computing and data location (FTRA, 2011).

In Ethiopia, teachers are tapping into Microsoft Azure Cloud to plan and download curriculum, keep track of academic records and securely transfer the student data to make it available throughout the education system. Danny Kim, chief technology officer of FullArmor, a Boston company working on the software deployment in the Ethiopian project, pointed out to two of the advantages of Cloud Computing as the biggest factors in helping these teachers in Ethiopia. They are: Low cost – The biggest problem for people in African countries and organizations trying to offer help in these countries are their tight budgets. They are handicapped by the lack of technology due to the high costs involved in using them. The low cost advantage of cloud computing can help them overcome this handicap; Faster time to market – Another big issue for Africa when it comes to tapping into

technology is the time consumed in the implementation. With cloud computing, this time is drastically reduced and it helps the organizations helping people and governments there in a big way (Subramanian, 2009).

Uganda is another example of Cloud computing in action in Africa through a collaborative project. Created in 2003, the Uganda Health Information Network set out to improve health workers' access to medical information and access to current health system data through the use of handheld computers, or PDAs, that could access the nation's 3G network to carry out data collection. A study of the project found that the instant transmission of medical information saw an average improvement in reporting between 20-85% for the regions where PDAs were implemented. It also found that another facet of the program, Continuing Medical Education (CME), greatly improved the quality of those health practitioners in the program. The cloud enabled CME learners to access the most recent information while in rural areas while also bringing down the costs of delivery of data. The challenges were the availability of cheap electricity to charge the users' PDAs and the incompatibility of software used to collect information between different PDA manufacturers (Kinkade, S. *et al.,* 2008).

In Kenya, banking institutions are now adopting the system with the aim of giving clients access to high-end services. SOFGEN, a Swiss firm is on top of offering the cloud service to financial institutions in Kenya. The firm established in 1999 introduced Temenos T24 Cloud Platform in the Kenyan market .It has provided solutions to banks like Kenya Commercial Bank, K-Rep Bank, Kenya Women Finance Trust and Commercial Bank of Africa. Their main target is the microfinance institutions, deposit taking microfinance institutions and Saccos. Due to their size, most of them cannot afford high-end core banking systems thus exposing them to fraud. According to Deloitte E.A, banks lost over Sh4 billion

to fraud in the 18 months to June with the fraud on the increase. According to SOFGEN, the Temenos core banking system will charge its services depending on the number of transactions carried out through the platform.

KenyanCloud is one of the first Cloud Computing Company in Kenya. Headquartered in Nairobi, Kenya, KenyanCloud seeks to bring cutting edge technology to Africa and provide tools to businesses and enterprises that would make them more competitive in the 21stcentury. Cloud Computing is new, revolutionary and is certainly the world's "next big thing". Their products and services are customized to meet the needs of each client.

This study concentrated on the KEMRI/CDC Field Research Station which is located in Kisian area near Kisumu City on the KEMRI Centre for Global Health Research (CGHR) campus. The Field Research Station is located in the western area of Kenya where *P. falciparum* malaria and HIV are major public health problems (KEMRI/CDC, 2012).

The collaboration includes support for HIV prevention and care programs and a state-of-the-art health and demographic surveillance system (HDSS) and other population-based platforms to assess disease burden, disease outbreaks and health intervention impact in communities. A key element of the KEMRI/CDC Research and Public Health Collaboration is the Health and Demographic Surveillance System (HDSS). Within the geographically defined area of the HDSS, scientists studying health-related issues are able to precisely monitor and measure interventions and their health impact. The HDSS collects data from 225,061 persons in 385 villages, in Nyanza Province, every four months.

1.2 Statement of the Problem

KEMRI/CDC is one of the largest collaborations with KEMRI and the Ministry of Health in Kenya. It deals with Medical Research and is one organization that is moving steadily towards keeping abreast of new technologies. Dating back to the year 2001 through 2008, the KEMRI/CDC HDSS used printed paper questionnaires to collect data from the demographically defined HDSS area (KEMRI/CDC, 2012). This came with its challenges since after the data was collected and entered into an electronic database, the papers had to be archived in a safe and secure environment until such a time that they would be destroyed as dictated by the Standard Operating Procedures (SOP). Other departments including procurement, Human Resource and Finance, equally have a large volume of sensitive paperwork heaped up in rooms and filing cabinets. Looking for a particular document in such a heap has proved to be very cumbersome, and at times forces the organization to hire casual staff to find it, especially during audits. This therefore forced the organization to invest in huge filing safes which occupy a lot of space. This is increasingly becoming expensive to the KEMRI/CDC management who rely entirely on donor funding. With the advent of cloud computing therefore, it has become increasingly desirable to have all the research data archived in the cloud for ease of access during audits. This has led to the urge to consider adopting cloud computing in order to save on space and to ensure protection and security of the very sensitive research data. It is therefore pertinent to investigate the level of preparedness of KEMRI/CDC towards this venture and to establish the challenges and prospects of success.

1.3 Purpose of the study

The purpose of this study was to do an analysis of preparedness towards adopting cloud computing technology at the Kenya Medical Research Institute/Centres for Disease Control at the Kisian Station, Kisumu County, Kenya.

1.4 Objectives of the Study

The study was based on four key objectives as outlined below:

1. To establish how infrastructure as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC.
2. To assess how staff knowledge as a component of preparedness influence the adoption of cloud computing in KEMRI/CDC.
3. To examine how staff skills as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC.
4. To examine how staff attitude as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC.

1.5 Research questions

The study was aimed at answering four research questions as listed below:

1. How does infrastructure as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC?
2. How does staff knowledge as a component of preparedness influence adoption of cloud computing in KEMRI/CDC?
3. How does staff skill as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC?

4. How does staff attitude as a component of preparedness influence adoption of cloud computing technology in KEMRI/CDC?

1.6 Significance of the study

KEMRI/CDC is struggling to effectively manage the unprecedented volume of data they are capturing. This includes enormous volumes of unstructured data such as filled questionnaire, staff files, purchase orders, payment vouchers and tender documents. Being a medical research organization, it majorly depends on data collected from various studies within its demographically defined areas of the HDSS; most of which is in paper form.

The results of this study may be useful in determining how the implementation of cloud computing may resolve this problem for instance, by making available all KEMRI/CDC data easily retrievable.

It is hoped that the results of this study would enlighten the KEMRI/CDC management and other organizations with similar manual data storage systems about the key prerequisites that would be considered if cloud computing adoption should be a success.

It is also hoped that the results of this study would inform the project heads on the importance of adoption of cloud computing on their research data, and how it will make retrieval of such information easy and scalable.

The results of this study may help KEMRI/CDC management to save on money and resources such as space, through the adoption of cloud computing which may recover the rooms used for paper storage and help to avoid building of more offices to accommodate the ever growing numbers of staff.

1.7 Basic Assumptions of the Study

The first assumption was that KEMRI/CDC staff and management would be willing to accept the adoption of the new technology for their everyday operations. Secondly, it was assumed that it would be received positively at the institution for the researcher to be able to collect adequate data to be able to answer the research questions. Thirdly, that the study findings would be used to generalize the determining factors for adoption of cloud computing.

1.8 Limitations of the study

Some limitations were foreseen; first, there was little prior research done on preparedness towards adoption of cloud computing. This would make the study rely on the collected data which could be biased to make generalized conclusions. This was overcome by concentrating the study in one organization and making conclusion based on this particular organization.

Secondly, being a new technology; it was projected to face rejection by the staff, especially those that are not tech savvy. This limitation was based on mentality and attitude to adopt change. Moreover some might feel that the technology may replace their duties within the organization, a notion that can be curtailed by sensitization workshop to create awareness on the subject matter.

1.9 De-limitation of the study

The study was delimited by location. It was conducted at the KEMRI/CDC Field Research Station which is located in Kisian area near Kisumu City on the KEMRI Centre for Global Health Research (CGHR) campus. Other stations of KEMRI/CDC namely Centres

for Clinical Research (CRC) located both in Siaya District Hospital and in Jaramogi Oginga Odinga Teaching and Referral Hospital; was not covered by the study.

Kisian Field station was selected for the study since it is the Headquarters of KEMRI/CDC in Kenya, and all the key departments including Human Resource, Procurement, Finance, Accounts, Stores, Transport and all research projects are housed in it. This made collection of data from the target population achievable in a short time frame.

Second, the study was delimited to adoption of only one component of cloud computing namely storage. It is intended to see all the hardcopy data digitized and saved in the cloud for ease of access and for reference. This is anticipated to change and include all the other products of cloud computing including deployment of services, infrastructure and applications, following success of the storage module.

1.10 Definitions of the Significant Terms used in the Study

Adoption of cloud computing: Gradual move towards eliminating all physical file storage, eventually leading to online storage and retrieval.

Infrastructure preparedness: The availability of a network infrastructure, dedicated bandwidth, adequate internet speed and a stable Local Area Network

Staff knowledge: Demonstration of awareness of the basic concepts of cloud computing

Staff attitude: Perception of staff towards the idea of adoption of cloud computing

Staff skills: Evidence of competence in computer operations related to the concept of cloud computing

Cloud computing: the use of computing resources i.e. hardware and software which are delivered as a service over a network typically the Internet.

1.11 Organization of the study

The research project report is organized into five chapters: chapter one which is the introduction, includes, the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, basic assumptions of the study, limitations of the study, delimitations of the study and definitions of significant terms. Chapter two contains the literature review and focuses on 4 key areas as described in the objectives of the study: infrastructure, staff knowledge, staff attitude and staff skills as a component of preparedness towards adoption cloud computing. It also highlight on the theoretical framework and conceptual framework. Chapter three focuses on the methodology to be employed. This includes the following sub-areas, research design, population, sample procedures and sample size, Instruments, validity and reliability, procedure for data collection and data analysis. Chapter four comprises data analysis, presentation and interpretation and lastly chapter five contains summary of findings, contribution to knowledge, conclusions and discussions. It also contains references and appendices. At the very end are the references and appendices.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section extensively reviews literature on the previous related studies relevant to the study topic. It is organized into the following sections: the concept of cloud computing, infrastructure as a component of preparedness towards adoption cloud computing, staff knowledge as a component of preparedness towards adoption cloud computing, staff attitude as a component of preparedness towards adoption cloud computing and staff skills as a component of preparedness towards adoption cloud computing. It also includes the conceptual framework and the theoretical framework of the study.

2.2 The concept of cloud computing

The first thing to understand is that “the cloud” is simply a metaphor for various data networks generally located somewhere far away and accessed via the internet. Despite what the name suggests, it has nothing to do with the stratosphere – and no, stormy weather can interfere with cloud computing, at least not unless there’s a major power outage. As a metaphor, “the cloud” simply denotes vast, distant clusters that we may not be able to interact with physically, yet which still affect us. In cloud computing, the clusters of servers, fiber-optic cables, and software engineers may be far away, but we can still interact with them by sending information back and forth (Turim-Nygren 2013). A study of 600 companies found that Latin American companies are the most aggressive adopters of cloud computing. The average large company in Latin America has almost two fifths (39%) of its

total applications in the cloud. Asia Pacific follows closely behind with over a quarter (28%). In contrast, less than one fifth (19%) of the average US company's applications are hosted in the cloud. In Europe, the figure is closer to one tenth (12%).

A global study by Tata Consultancy Services (TCS) projects the number of corporate cloud applications to become much more pervasive by 2014 – up to 54% (Latin America), 52% (Asia Pacific), 33% (US) and 24% (Europe) of total corporate applications.

The latter study accordingly confirms that overcoming the fear of security risks remains the key to adopting and benefiting from cloud applications. While companies globally admitted this is the biggest challenge to leveraging cloud today, those in the US and Europe remain especially conservative in their approach to cloud adoption for the fear of data security breaches. Despite a significant shift to cloud applications, Western companies are also more sensitive about which applications they put in public clouds. Only a fifth (20%) of US and European companies would consider or seriously consider putting their most critical applications in public clouds. Yet, two-thirds of US (66%) and almost a half of European companies (48%) would consider putting core applications in private clouds. Companies in Europe and in the US also showed a reluctance to put applications with customer data in the cloud

In the US and Asia-Pacific, companies cited the standardization of software applications and business processes as the main driver for shifting on-premise applications to the cloud. In Europe and Latin-America, the ability to ramp systems up or down faster was the motivation. It is projected that the greatest growth surge in cloud migrations in the US will take place among mid-sized corporations, defined as those bringing in between

$500 million and $5 billion a year. A majority, or close to it, of corporate applications may end up in the cloud in a matter of a couple of years at these companies.

Table 2.1: Plans for cloud adoption, by percentage of corporate applications (US companies)

Year:	2011	2014
All sizes	19%	34%
$500m-$1b	16%	44%
$1b-$5b	27%	52%
$5b-$10b	28%	31%
$10b-$20b	17%	35%
$20b-$50b	17%	30%
>$50b	14%	23%

Source: Tata Consultancy Services (TCS)

Cloud computing enables and facilitates the provisioning of numerous kinds and diverse flavors of services. It is however possible to group these services as per the mode of their delivery. According to the NIST, Cloud services are delivered within three types of delivery models which are SaaS, PaaS, and IaaS. (Mell & Grance, 2009). Aside from these three categories, three further service delivery models have been introduced in a distinguished talk by industry expert Stephen Hanna of Juniper Networks (Hanna, 2009). Adopting all these categories, Cloud service delivery models are categorized in six types which are Software as a Service (SaaS), Data as a Service (DaaS), Network as a Service (NaaS), Platform as a Service (PaaS), Identity and Policy Management as a Service

(IPMaaS), and Infrastructure as a Service (IaaS). Cloud deployment models are basically categorized into four different types based on specific requirements of the consumers. These are: Public Cloud, Private Cloud, Community Cloud, and Hybrid Cloud (Mell and Grance, 2009).

2.3 Infrastructure as a component of preparedness in adopting cloud computing

The number of businesses globally that are deploying cloud to either remotely host applications or host data (or both) stands at 37 %, with North America and Asia being most advanced in their implementation of cloud solutions.

Globally, the majority of organizations are at the stage of "investigating the technology", with only a very small number (3 %) having rejected the move to cloud, outright. The adoption and level of engagement around cloud points to the fact that organizations needs and IT environments across the world are as unique as ever, leading to a staggered uptake of cloud models (AMD 2011). With such a significant percentage of organizations evaluating cloud globally, this suggests we can expect an even greater wave of cloud deployments in the near future as these organizations move from investigation to implementation.

Statistically proven figures show that 80% of the computing power is not efficiently used, neither is 65% of the storage of servers. Hence there is a huge potential to share resources in order to use them in a cost efficient way rather than underutilizing them (Armbrust et al., 2009).

Instead of investing in their own corporate server or network infrastructure, companies are able to purchase those resources on a rental basis and use it on demand rather than having their own resources locally. The providers are taking care of the servers, storage and

network settings, while the client has virtual instances of that (Armbrust *et al*., 2009; Buyya *et al*., 2009).

Amazon Web Services is one example of that, where infrastructure is available on a pay-per-use self-service basis and get servers, storage, network configuration, set all that up and run it, while not having to worry about co-location, rental or datacenters (Amazon, 2009).

A common discussion between vendors of cloud solutions and organizations using the technology is on what hardware and software is powering the cloud. The results of the study by AMD, proved overwhelmingly that infrastructure matters. Ninety-two percent of businesses already using cloud computing stated that the infrastructure – the servers, software and underlying technology - was important in the selection of a cloud solutions provider. This indicates that businesses care about the technology powering the cloud, given that failure of any of that technology could have dramatic implications on the IT services being delivered to employees. This also clearly indicates that IT vendors need to take the lead in the conversation about optimized hardware and software for the cloud beyond buzzwords. It is time for better education of the market so that customers can make the right infrastructure decisions (AMD 2011).

Bandwidth continues to propagate the earth at alarming speeds, while at the same time decreasing in price. Many people claim bandwidth is the big limiting factor of cloud, yet it is continually becoming extremely prevalent and fast. In addition Aso, 4G, fiber optic, wireless, and better technology to increase speeds over copper, will continue to diminish this road block. This increase in availability also creates commoditization as broadband services become faster and the difference between brands decreases. In this scenario, consumers

usually buy the cheapest since they all appear the same. As this happens, availability as a reason to not move to cloud computing will disappear (Neilsen 2012).

KEMRI/CDC has a stable network infrastructure with 8MB dedicated bandwidth from Orange Telkom, which is transmitted to the centre via microwave from Kisumu Town and from Nairobi to Kisumu through fibre optic cable. It also has a redundant 2MB internet bandwidth from another Internet Service Provider (ISP), Safaricom; which comes into play when there is failure from Orange Telkom to ensure business continuity in the centre. This kind of setup is sufficient to accommodate cloud computing.

2.4 Staff knowledge as a component of preparedness in adopting cloud computing

AMD, through the same research, indicated that there was a very clear focus on developing the skills in-house to deploy cloud solutions, rather than contracting that expertise in via a third-party. This indicates that cloud is both a long term, strategic investment for businesses that requires in-house knowledge to drive the transition over months and years, not just isolated implementations (AMD 2011). As cloud computing continues to mature and gain adoption, it is critical that more education is provided to ensure the industry fully understands the nuances of the technology.

More education is needed to ensure customers in all regions and sectors are on equal footing with the cloud. This can come in the form of more clear communication from IT vendors about what their solutions deliver, as well as webinars, in-person events, and hands-on engagement about how to improve IT operations in the cloud.

Not all enterprises are racing to the cloud. Just as they have with new technologies and delivery systems for applications, storage and security, enterprises are taking a “walk before

you run" approach to cloud-computing adoption. In fact, even by 2015, only 30 % of Fortune 500 companies will have migrated at least one mission-critical application to a cloud environment, according to Gartner. Many enterprises will take a cautious approach to cloud computing by adopting a select few applications or services in isolation. They will not make a full commitment until they gain confidence in reliability, economic benefit, security and scalability.

Cloud adoption accelerators are solutions designed to simplify the bridge between the enterprise's operational environment and the service provider's cloud platform. The combined environments need to be managed, secured and operated as one. By the service provider simplifying the migration process and creating a transparent link, they create a trusted relationship with their customer.

Safaricom Cloud and Managed Services Senior Manager George Makori said in a press release during the launch of Safaricom Cloud that I.T staff should not be worried of job security since Safaricom Cloud was not aimed at facilitating job cuts in their organization but instead will require them to upgrade their skills. He further added that Safaricom Cloud would help improve, protect and grow business because users would be able to carry out their duties with minimum capital. This therefore will work to keep the I.T staff on toes to the realization of the objectives of this study and to prove their competency in their various positions.

2.5 Staff skill as a component of preparedness in adopting cloud computing

Major IT transformations such as the transition from mainframe to minicomputers to PCs, or to networked computing, required an evolution of technology as well as an evolution of skills and organizational structure. Cloud computing alike, will require the same. Without

organizational change and the acquisition of new skills and knowledge, a successful transition to cloud computing will be impossible.

The adoption of cloud-based applications and outsourcing of services through cloud-delivered mechanisms is gaining in popularity. This is due primarily to the unique value proposition of cloud computing, which boasts at least two key benefits for customers: First, companies that utilize cloud computing tend to have leaner, more nimble, and better adaptable IT environments, and are better able to control their IT spend. Second, companies inclined to reduce capital expenditures have the ability to shift their cost structures accordingly (Thethi, 2009).

According to AMD, one key hurdle that still remains for the public sector to fully embrace cloud computing is having the necessary IT skills in-house to support the deployment of cloud solutions. Currently, 43 % of public sector respondents did not feel they had the skills in place to support cloud versus only 23 % in the private sector (AMD 2011).

Cloud customers pay for only the computing resources they use rather than purchasing or leasing equipment that may not be fully utilized at all times. If cloud computing is used to meet all the technology needs of an organization, there are no longer physical space requirements and utility costs traditionally associated with maintaining a dedicated data center environment. An organization that obtains all of its computing resources from a cloud service provider can expense all the dollars (i.e., receive a U.S. tax benefit). This tax benefit does not typically apply to internal dedicated data centers in which capital expenditures and amortization factors are involved.

Cost is a very important factor and opportunity in Cloud Computing. "Cost advantages are the strongest driver affecting IT executives' perceptions of SaaS opportunities" (Benlian and Hess, 2011, p. 1).

Marston et al. (2011) stated that companies need to spend a big part of their balance on the IT infrastructure, while less than 10 % of their servers can be really utilized, resulting in a big waste of money. In addition, these servers need to be replaced almost every three years and need to be maintained and administrated, increasing the total cost of IT operations radically (Marston et al., 2011).

Cloud Computing can reduce these costs remarkably. “Economies of scale for datacenters cost savings can lead to a five to seven-time reduction in the total cost of computing” (Marston et al., 2011, p. 6).

2.6 Staff attitude as a component of preparedness in adoption of cloud computing

Attitude can be a very powerful enabler or a barrier towards the adoption of the new technology. Ajzen (1988) defines the term “attitude” as a complex conundrum of feelings, desires and fears that create a state of readiness to act within a person. Moreover, Fazio (1990) defines an attitude as a learned association in memory between an object and a positive or negative evaluation of that object, and attitude strength refers to the power of the bond in this respect.

Regionally attitudes towards the cloud differ greatly. For example, one in four public sector organizations in the US and Asia are concerned about storing customer data in the cloud which drops to only one in 10 in Europe. Asia is also much more likely to store their HR information in the cloud, while Europe is more likely than any other region to move back- office applications into a cloud environment. The same study by AMD shows that

public sector organizations are predominantly moving web serving (35 %), email (32 %) and finance/accounting (25 %) applications into the cloud. Asia follows that trend with web serving (32 %), email (32 %) and HR (29 %) applications proving most popular while businesses in Europe are focused on moving finance/accounting (28 %), back office (24 %), web serving (24 %) and email (24 %) applications (AMD, 2011).

AMD also specifically examined public sector attitudes toward the cloud, revealing that local and federal mandates are having a significant impact in accelerating cloud adoption. In the US, public sector respondents felt government policies have accelerated a move to the cloud more than twice as many times as those who felt it has decelerated adoption, primarily citing the shift as a way to reduce costs. Nearly half of the worldwide public sector respondents indicated budget restrictions are driving a more rapid adoption of cloud solutions (AMD, 2011).

The IT department in organizations will be the most affected by the adoption of cloud computing (Mather *et al.*, 2009). These departments are used to having control over different aspects of organization IT infrastructure operations and management. They control such things as IT procurement, IT asset management, security control and billing (Khajeh-Hosseini *et al.*, 2010a). With cloud computing, this will change. In 2008 Nicholas Carr argued that the mode of IT service delivery resembles in some aspect that of electricity delivery in the early days of electric invention (Carr, 2008). During that time every manufacturer had to generate their own electricity regardless of the type or nature of their business. In the same respect today's business organizations build their own IT infrastructure regardless of their business (Carr, 2008, Khajeh-Hosseini *et al.*, 2010b, Khajeh-Hosseini *et al.*, 2010a). This trend results in inefficient IT infrastructures

(Economist, 2008). Cloud computing is about to change that. This will be possible through cloud computing provision of facilities such as computational power, storage capacities and offer these as utility services.

With the organizational changes that are imminent from adoption of cloud computing, governance and risk management of IT resources in the cloud environment is another challenge facing organizations. Effective management of IT resources in cloud environment and risk management should be a result of an organization having a well-developed IT resources and information security governance processes, as part of the organizations' corporate governance obligations (CSA, 2009). The results of a well-developed governance processes are information security management processes that are flexible, repeatable, measurable, sustainable, defensible, and cost-effective on an ongoing basis (CSA, 2009). For cloud computing the main concerns to organizations in relation to governance and enterprise risk management is how the organization can identify and implement appropriate organizational structures, processes and controls to ensure that there is effective information security governance, risk management and compliance (CSA, 2009,Buyya *et al.*, 2009, Armbrust *et al.*, 2009, Golden, 2009). The governance and risk management requires organizations to ensure that there are proper mechanisms and processes across the information supply chain that covers cloud providers, customers and other stakeholders, and supporting third parties to vendors (Golden, 2009, CSA, 2009).In order for organizations to ensure effective governance and risk management, there is a need for both vendors and customer to collaborate in developing appropriate organizational structures, processes which will ensure good governance and risk management. But this is not an effortless endeavor as it is not likely for vendors to be able to develop these processes with every customer without

jeopardizing their ability to offer their services. The Cloud Security Alliance (CSA, 2009) offers a number of recommendations.

The need for specific SLAs is another challenge. This is a challenge due to the fact that vendors may not always meet the requirements for SLA of an organization. The potential for down-time and lack or inadequate SLA agreement from some cloud vendors pose a great challenge (Google, 2010, Golden, 2009, Amazon, 2010).

2.7 Theoretical framework

Technology adoption frameworks are information system theories that have been used in studies of innovation diffusion and adoption, and to provide a theoretical base for examining the factors influencing technology adoption in organizations (Davis et al, 1989). One of the most utilized models in studying information technology adoption and diffusion is the Technology Acceptance Model (TAM) (Davis et al, 1989). Developed by Davis in 1989, its goal is to provide a basis for tracing the impact of external factors on user's attitudes and intention to accept new technologies (Davis, 1989). The TAM is based on the Theory of Reasoned Action (TRA) (Fishbein, 1980), which is concerned with the behavior of technology users towards a new technology.

The TAM suggests that when users are presented with a new technology, there are two main factors that influence their attitude to use it, namely: „perceived usefulness" (PU) and "perceived ease of use" (PEOU) of the technology. Perceived usefulness (PU) was defined by Davis 1989:320) as the degree to which individuals believe that using a particular system would enhance their job performance, whereas perceived ease of use (PEOU) refers to "the degree to which individuals believe that using a particular system would require no effort".

According to Davis et al (1989), PEOU and PU have the capability to determine the actual use of the new technology.

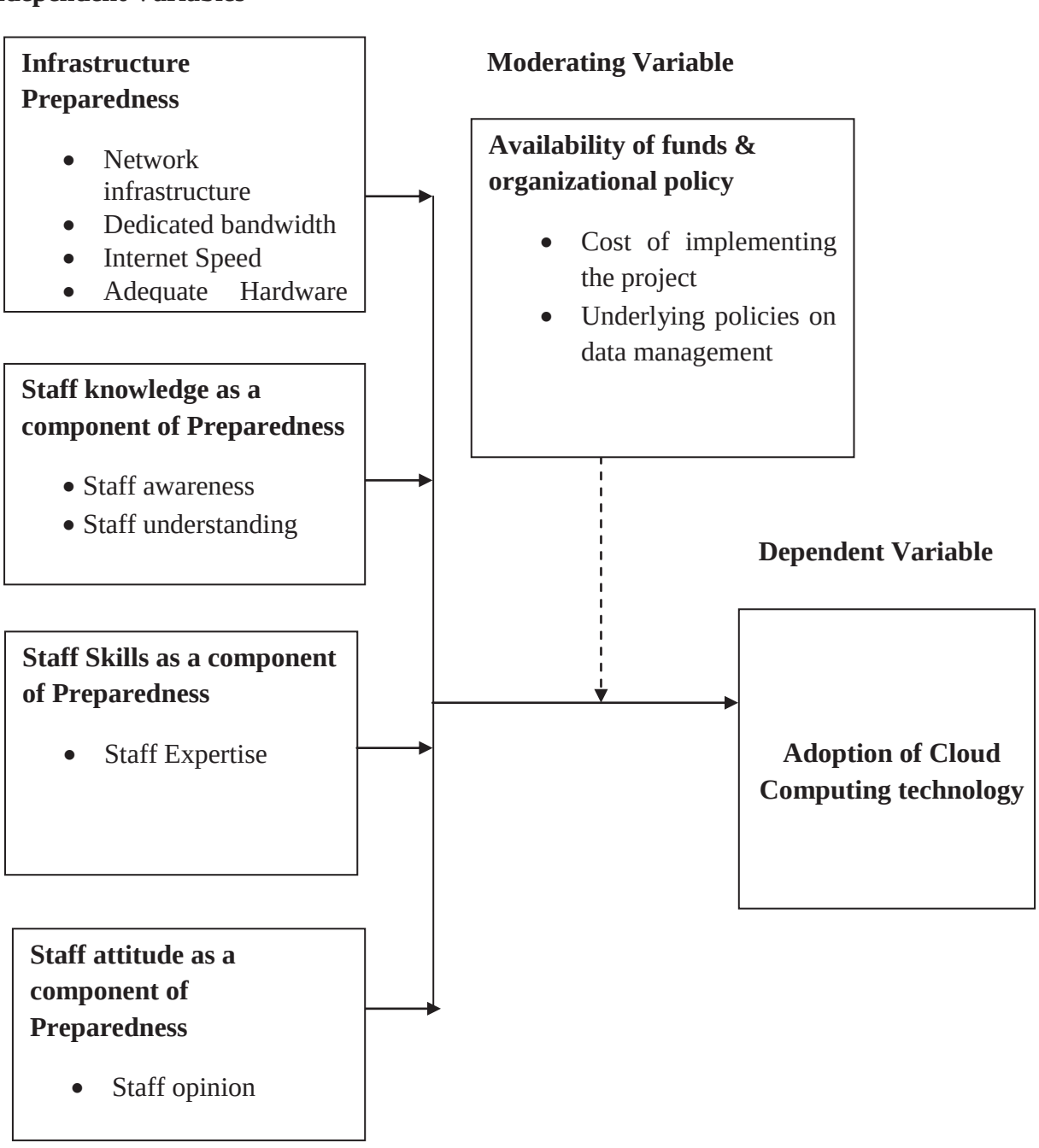
The TAM has been used widely in many studies (e.g., Davis, 1989; Venkatesh, 1996; Adams et al, 1992; Segars and Grover, 1993; Succi and Walter, 1999; Matheson, 1991; Lu et al, 2003; King and He, 2006) with different domains and in different situations to predict the behavior intentions to use a technology as well as actual use of technology (Al-Gahtani, 2001). It has been found that the TAM‟s ability to explain attitudes towards using a particular information system is better than other models (such as the TRA and TPB) (Mathieson, 1991). The most likely reason is that the two components of the TAM have received more empirical support than the TRA and TPB, and in addition, the model has the ability to consistently explain a significant amount of the variance in usage intention and behavior. For instance, the TAM was used in predicting the application of several information technologies such as microcomputer word processing software (Anandarajan et al, 2000), general information systems (Jackson et al, 1997), and computer spreadsheets (Mathieson, 1991).

Although the TAM has been tested in many studies, and has proved to be a valid and reliable framework explaining acceptance and adoption of different technologies, there has been some disagreement over the exact variables affecting the acceptance of new technologies (Jackson et al, 1997).

2.8 Conceptual framework

This study was guided by the following conceptual framework.

Figure 1: Conceptual Framework



Preparedness of an organization, is key to the anticipated success for the adoption of cloud computing, which is a significant evolution. The independent variables in this study are: infrastructure as a component of preparedness, staff knowledge as a component of preparedness, staff skills as a component of preparedness and staff attitude as a component of preparedness; which would affect the adoption of cloud computing technology in one way or the other.

The key aim of this study is to attain an upscale data storage and management in KEMRI/CDC though adoption of cloud computing. This will entail digitizing all the paper documents, storing them in the cloud, controlling access to the documents by implementing rights and authentication levels and managing version control of documents whereby track of edits and alterations are monitored and stored separately, not affecting the original document.

Factors that come into play to ensure achievement of the goal are called the moderating variables. In this study, the moderating variable was the availability of funds; and the factors that would be considered include the cost of implementation of the project, cost of hiring temporary for the initial phase of the project and the cost of training staff on the new technology. Cloud computing implementation, which is our ultimate goal, comes with a lot of benefits to KEMRI/CDC. It will change the way ICT will deliver computational infrastructure to end users. It will provides massive off-the-site storage of research data and important organizational records and will also be used to deploy software to all the computers, laptops, tablets and smartphones in KEMRI/CDC network, enabling adequate management of the organization's resources.

2.9 Summary of literature review

This chapter has extensively discussed work previously done on cloud computing and the patterns of its adoption throughout the world. It has recognized the work done by previous scholars by adequately citing them.

Literature reviewed under the organizations' infrastructure as a component of preparedness, has shown that hardware and software are powering the cloud and must be critically assessed before adoption of the technology. Other aspects of the infrastructure reviewed include the bandwidth, internet speeds and network infrastructure and how they impact the adoption of cloud computing.

Literature reviewed under staff knowledge as a component of preparedness exposed the importance of in-house training of staff that will be affected by the adoption of cloud computing. It has also highlighted the importance of empowering staff through certification trainings especially the IT personnel who will be the key persons handling the entire project.

Literature reviewed under staff skill as a component of preparedness revealed how easy it would be for the IT staff to accept and use the new technology since they would have a better understanding of the advantages that come along with the adoption of the new technology.

Literature reviewed under staff attitude as a component of preparedness clearly displayed the importance of sensitization and awareness training on cloud computing to staff before adoption of the technology. It also showed that new systems face rejection by staff most especially due to the approach used in introducing it.

It is clear from the literature reviewed that for adoption of cloud computing to be a success, then an organization ought to be prepared in terms of its infrastructure, its staff knowledge, skills and attitude and in terms of its finances.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology that was used in conducting the study in order to get information aimed at meeting the research objectives and answering research questions. These are described under the following headlines: Research design, target research population, sample selection and sample size, research instrument, data analysis and ethical considerations.

3.2 Research design

This study adopted a descriptive survey design which is a onetime study with focus on attention on formulation of objectives, designing the data collection instrument, selecting the sample, collecting the data, processing and analyzing the data and reporting the findings (Mugenda & Mugenda, 2003). The aim was to collect information from respondents on their knowledge, skills and attitudes in relation to preparedness towards adoption of cloud computing in KEMRI/CDC Kisian Campus.

This design presents oriented methodology used to investigate populations by selecting samples to analyze and discover occurrences. It describes events as they are. It facilitates rapid data collection and ability to understand population from sample (Oso and Onen 2009). Descriptive survey design is used in the preliminary and exploratory studies to allow the researcher gather information, summarize, present and interpret it if for the purpose of clarification (Kombo and Tromp 2006). The research design adopted would

allow the researcher to describe record, analyze and report conditions that exist and would also allow the researcher to generate both inferential and descriptive data that is meant to assist in determining associations between the variables.

3.3 Target population

The study was conducted at The KEMRI/CDC Field Research Station which is located in Kisian area near Kisumu City on the KEMRI Centre for Global Health Research (CGHR) campus. The Field Research Station is located in the western area of Kenya (KEMRI/CDC, 2012).

The target population for this study was all employees of KEMRI/CDC based at the CGHR campus, both male and female, working in all the twenty different departments of the organization. According to the Human Resources department, KEMRI/CDC has a population of 1,300 staff.

3.4 Sample size and Sample selection

This section explains how the sample size for the study was achieved and the criteria that were used to select a sample from the whole population identified.

3.4.1 Sample size

Sample size estimation from a proportion can be done using the method below, at a confidence level of 95% and error level of 5 % (Yamane, 1967).

$$n = \frac{N}{1 + N (e)^2}$$

Where n = Desired Minimum sample (When the population is less than 10,000)

N = the total Population

e = Level of precision at 95% confidence level e=0.05.

e^2 = $(0.05)^2$ = 0.0025

Therefore, Sample size (n) =

$$n = \frac{1300}{1 + 1300\,(0.0025)}$$

$$n = \frac{1300}{1 + 3.25} = \frac{1300}{4.25}$$

n = **305**

From the above formulae, a sample size of 305 is obtained. A margin of relative error of 5 percent at the 95 percent confidence level on the key indicators was estimated and additional 10% of the sample size was added to cover for the anticipated non-response and spoilt tools (United Nations, 2005). This therefore brought the total minimum sample size required to be 305 staff.

3.4.2 Sample selection

A sample is a section of the population that is suitable enough to represent the characteristics of the whole population. A sample size must be large enough to adequately represent the significant characteristics of the reachable population (Mugenda and Mugenda 1999). Selection of the sample size depends on factors such as the number of variables in the

study, the purpose of the study, population size, the risk of selecting a "bad" sample, the type of research design, the method of data analysis and the size of accessible population and the allowable sampling error (Israel, 1992).

Proportional sampling method was adopted during data collection. Questionnaires were administered at the KEMRI/CDC station in CGHR Campus in all the different departments.

Proportional sampling provides the researcher a way to achieve even greater representativeness in the sample of the population. This is accomplished by selecting individuals at random from the subgroup in proportion to the actual size of the group in the total population. Proportional sampling is used in combination with stratified and cluster sampling (Van Dalen, 1979).

The respondents were categorized into strata. When subpopulations within an overall population vary, it is advantageous to sample each subpopulation (stratum) independently. Members of the population were divided into homogeneous subgroups before sampling. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum.

Each department in KEMRI/CDC made up a stratum. There are twenty departments within KEMRI/CDC, each made up of staff at different levels, namely: directors, senior managers, managers, supervisors and staff in different capacities as per the department. These strata guided the sampling, with each being covered at a specified and allocated time. Within the strata, respondents were clustered as per their job groups and asked to fill in a questionnaire. Inclusion criteria included: KEMRI/CDC staff stationed at the CGHR Campus including interns that had been in KEMRI/CDC for more than six months.

3.5 Research instruments

The study used a questionnaire to collect the required information. The questionnaire was structured into six broad categories. It started with the background information of the respondent, which key aim was to identify the department of the respondent, the profession, the age and years of service at KEMRI/CDC. The Second section gathered information about what the respondents knew about cloud computing. The third section gathered information about infrastructure as a component of preparedness towards adoption of cloud computing. The forth gathered information about staff knowledge as a component of preparedness towards adoption of cloud computing. The fifth gathered information about staff skills as a component of preparedness towards adoption of cloud computing; and the sixth section gathered information about staff attitude as a component of preparedness towards adoption of cloud computing.

The researcher administered questionnaires to the target population, handling each department at a specified time.

3.5.1 Pilot testing

Pilot-testing is an important step in the research process because it reveals vague questions and unclear instructions. It also captures important comments and suggestions from the respondents that enable the researcher to improve efficiency of instruments, adjust strategies and approaches to maximize response rate. Pilot testing is an important step in testing the data collection tool to ensure that quality data is collected at the end of the study. In pilot testing the data collection tool is used to collect information from real participants in the study area (Nachmias and Nachmias 1996)

The data collection assistants administered the questionnaires to the staff in ICT and Data departments in Kisian before commencement of the study. Clarification was made regarding the nature of the study and the participants were informed that the data collected was to be used for testing the data collection tool and not for the purpose of the study. The data collected was analyzed and interpreted. After completion of the pilot testing the data collection tool was reviewed by the investigator together with the data collection team. Suitable corrections and adjustments to the tools were made to make it fit for use in the study.

3.5.2 Validity of the instrument

Validity of the instrument is the accuracy, truthfulness and meaningfulness of inference that are based on the data obtained from the use of a tool or scale for each construct or variable in the study. Validity establishes the relationship between the data and the variable or construct of interest (Mugenda and Mugenda 2003)

It is not possible to determine validity from the instrument alone, therefore, data collected during the pilot testing was used to determine and establish validity. From the feedback of the pilot testing, the questionnaires was corrected and adjusted as appropriate to ensure suitability for the intended use.

3.5.3 Reliability of the instrument

Reliability measures the degree to which a research instrument would yield the same result or data after repeated trials. It is influenced by random errors that may arise from coding, ambiguous instructions, to interviewer and interviewee fatigue, bias among others (Mugenda and Mugenda 2003). Reliability can also be defined as the proportion of variance

attributable to the true measurement of a variable and estimates the consistency of such measurement over time. (De Vellis, 1991)

In this study reliability testing was done by using test-retest method. The questionnaires were administered to selected staff (10% of the sample size) from CGHR campus. The questionnaires were then administered to the same group of staff after a period of 1-2 weeks. The result of the test-retest was factored into statistical test to determine correlation between the test and the retest. Perfect correlation was not possible because of the confounding factors and therefore a Karl Pearson's correlation coefficient of 0.7-0.9 was accepted (Kathuri and Pals, 1993). The Karl Pearson's formula for correlation was used:

$$r = \frac{\sum(y-\boldsymbol{Y})(x-\boldsymbol{X})}{\sqrt{\sum((y-\boldsymbol{Y})^2 \sum(x-\boldsymbol{X})^2}}$$

r =Karl Pearson's coefficient of correlation y=Values of the first test

x=Values of the retest ***Y*****=**Mean of the first test

X**=**Mean of the retest

If the above method is not used then equivalent form method was be employed within the above sample size.

3.6 Procedure for data collection

The data collection team underwent a rigorous training on research ethics, data collection process and use of data collection tool. During this training the data collection personnel also read through the questionnaire to ensure that all the questions were clear. All the answers provided were completed in appropriate spaces in the questionnaire. Data

collection process took approximately 7 days because some departments had scheduled duties which could not be interfered with, therefore the data collectors were given upto 3 chances in an attempt to contact the potential study participant.

3.7 Data analysis techniques

After all the data was collected using the questionnaire, they were all scanned into Teleforms software and the data entered was verified using the original questionnaires. The data was set to automatically load into a Microsoft Access database, making the data available in a ready form without having to manually enter it. The data was cleaned and the database was then exported to SAS (Statistical Analysis System), statistical software for analysis and further cleaning. The researcher used descriptive and inferential statistical analysis to come up with associations (Chi Square), Odds Ratios and frequency distribution regarding adoption of cloud computing.

3.8 Ethical Issues in Research

Protecting the right and welfare of the participants was the major obligation of the investigative team. The research proposal was reviewed and approved by a panel of distinguished lecturers, supervisors and National Council for Science and Technology (NCST) before it could be conducted. The investigator also ensured that privacy of the participants and confidentiality was maintained through the entire study. Participants were identified only by study file numbers to conceal their personal identity. Informed consent was determined verbally from all participants prior to participation in the study, participation was voluntary and participants were at liberty to withdraw from the study at any time without any consequences.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents questionnaire response rate, the background information of KEMRI/CDC staff, results on basic concept knowledge on cloud computing, results on knowledge on cloud computing of respondents, attitude on adoption of cloud computing of the respondents, skills of respondents on cloud computing. The chapter reports how these factors may influence adoption of cloud computing in KEMRI/CDC Kisian Station.

4.2 Questionnaire return rate

A total of 315 questionnaires were sent to be administered and 300 questionnaires were returned for analysis yielding a response rate of 95.2%. This response rate was achieved as a result of proper rapport with the respondents and with the administration of KEMRI/CDC and also adequate information dissemination to the members of staff at the Kisian Campus on the importance and purpose of the study. This high rate was also achieved as a result of high interest in the hype about cloud computing.

4.3 Demographic Characteristics of Respondents

This section describes the demographic characteristics of the respondents. The demographic information was collected on age, profession and years of service. It is important to note that profession was recoded to field of specialization. These results were

presented as follows in three themes namely; the respondents' age, respondents' field of specialization and respondents years of service.

4.3.1 Distribution of the respondents by age

The study found it important to analyse age distribution of the respondents. This was important because the study wanted to know if cloud computing knowledge is associated with age. Due to this, the respondents were asked to shade the age category they fell in and the results are given in table 4.1.

Table 4.1: Distribution of the respondents by age

Age category	Frequency	Percentage
18-25	64	21.4
26-35	133	44.3
36-40	70	23.3
>= 41	33	11.0
Total	300	100.0

Table 4.1 shows that majority of respondents 133(44.3%) were between 26 to 35 years of age, 70(23.3%), 64(21.4%) and 33(11%) were between, 36 to 40, 18 to 25 and above 40 years of age respectively in this organization. This indicated that there were more employees below 35 years of age in KEMRI/CDC.

These results contradict with the results of a survey done in Central Europe which indicated that Turkish and Romanian researchers are the youngest, with an average age of 39 years. The oldest age is found in Bulgaria (50), followed by the Czech Republic (47). This

indicates that in these countries young scientists have fewer opportunities to enter the research community, which is still dominated by the 'old guard' (CEC, 2005).

4.3.2 Distribution of the respondents by field of specialization

The study sought to establish the field of specialization of the respondents who filled the questionnaires. The study sought to know this distribution because it is important as this would be one factor that could determine the respondents' knowledge, attitude and practices with regard to cloud computing. The respondents were therefore asked to state their profession which the researcher recoded to the field of specialization variable and summarized in table 4.2.

Table 4.2: Distribution of the respondents by field of specialization

Field of specialization	Frequency	Percentage
Administration	72	24.0
Data and I.T	85	28.3
Field work and research	116	38.7
Maintenance	27	9.0
Total	300	100.0

The Findings in table 4.2 show that 116(38.7%) of respondents were in field work and research category, 85(28.3%), 72(24%) and 27(9%) were in data and Information Technology category, Administration and maintenance categories respectively. This is important to take note of because, the field of specialization is likely to influence the knowledge and attitude of respondents towards adoption of cloud computing.

KEMRI/CDC being a Medical Research organization, its core business is research, with a majority of its staff comprising of researchers. Once data is collected, the Data and I.T professionals come into play to have this data translated coded and analyzed to come up with trends that will help KEMRI/CDC make informed decisions.

4.3.3 Distribution of the respondents by years of service

The study sought to establish the number of years the respondents had served the organization. This distribution was important because it would be a factor that could determine the respondents' knowledge of the organizations infrastructure preparedness and capability to adopt cloud computing, attitude and practices with regard to cloud computing. The respondents were therefore asked to state the number of years they had served the organization and the results were summarized in table 4.3.

Table 4.3: Distribution of the respondents by years of service

Years of service	Frequency	Percentage
< 3	129	43.0
3-5	63	21.0
5-10	77	25.7
> 10	31	10.3
Total	300	100.0

The Findings in table 4.3 show that 129(43%) of respondents had served less than 3 years in the organization, 63(21%) had served the organization for between 3 to 5 years, 77(25.7%) had served for between 5 to 10 years whereas 31(10.3%) had served the

organization for more than 10 years. It was important to take note of this because it would influence the respondent's recommendation.

These results concur with the KEMRI/CDC policies and regulations which state that a staff is hired on contract basis, usually 1 year renewable and subject to availability of funds. The above distribution shows a large number of staff having worked for less than 5 years.

4.4 Introducing the concept of cloud computing

In this section the study sought to know whether the respondents had the concept of cloud computing. The results were presented as follows.

4.4.1 Distribution of the respondents by having an email account

The study sought to establish the number of respondents who owned a Gmail, yahoo, Hotmail or Facebook account. The study sought to know this distribution because this would be a factor that would help determine the respondents' practises and knowledge of cloud computing. The respondents were therefore asked whether they owned any of the stated accounts and the results summarized in table 4.4 below.

Table 4.4: Distribution of the respondents by having an email account

Responses	Frequency	Percentage
Have	292	97.3
Do not have	8	2.7
	300	100.0

The Findings in table 4.4 shows that majority, 292(97.3%) of respondents have email accounts while only 8(2.7%) did not have. KEMRI/CDC has an online portal for job applications, of which email account is a requirement. Though it is a relatively new innovation, most staff on employment were required to provide email accounts together with their mobile phone numbers for communication purposes. Very few respondents 8(2.7%) do not have this, an indication that they are either not conversant with them or are comfortable with the organization's email structure. This is a clear indication that most respondents are actually using cloud computing technology without actually knowing they are.

4.4.2 Distribution of the respondents by ability to access mails from anywhere

The study sought to establish the respondents' ability to access mails from anywhere. The respondents were therefore asked whether they had the ability to access their mails from any location with internet connectivity and the results summarized in table 4.5 below.

Table 4.5: Distribution of the respondents by ability to access mails from anywhere

Responses	Frequency	Percentage
Yes	267	89.0
No	21	7.0
Don't Know	12	4.0
Total	300	100.0

The Findings in table 4.5 shows that majority, 267(89%) of respondents were able to access their mails from anywhere as long as there was internet connectivity, 21(7%) could not while 12(4%) did not know. Those who responded as no and don't know clearly indicate

that they have no idea of whether they can access their emails from anywhere as long as they have internet access.

Counselor Systems Inc. (CSI) confirms that E-mail access is available via "web-access" using any of the standard Internet browsers (Internet Explorer, Firefox, Chrome, Opera or Safari) as long as you have internet connection (CSI, 2013).

4.4.3 Distribution of having heard of cloud computing

The study also sought to know whether the respondents' had heard of cloud computing. This was important as it could determine the respondents' knowledge, attitude and practises towards cloud computing. To assess this, the respondents were asked whether they had ever heard of cloud computing. The findings were summarized in table 4.6 below:

Table 4.6: Distribution of the respondents having heard of cloud computing

Responses	Frequency	Percentage
Yes	211	70.3
No	89	29.7
Total	300	100.0

The Findings in table 4.6 shows that majority, 211(70.3%) of respondents had heard of cloud computing while 89(29.7%) had not heard of cloud computing. Cloud computing is a new term in the computing world (Luis et al., 2008, Buyya et al.,2008) and it signals the advent of a new computing paradigm (Luis et al., 2008). This new paradigm is quickly developing and attracts a number of customers and vendors alike. The quick development of cloud computing is being fuelled by the emerging computing technologies which allows for

reasonably priced use of computing infrastructures and mass storage capabilities. Being a new term in the technological field, it is therefore evident that a good percentage of respondents had not heard about it, and even those who had heard of it, could not explain what it actually is.

4.4.4 Relationship between field of specialization with having heard of cloud computing

The study also sought to know whether there was any association between respondents' field of specialization with knowing about cloud computing. This was important to assess, as it would inform the researcher of the relationships and associations of these variables believing that they could affect adoption of cloud computing within this organization. The findings were summarized in table 4.7 below.

Table 4.7: Distribution of the respondents' field of specialization by having heard of cloud computing

Field of specialization	Responses			
	YES		NO	
	Freq	%	Freq	%
Administration	52	17.3	20	6.7
Data and it	74	24.7	11	3.7
Field work and research	72	24	44	14.7
Maintenance	13	4.3	14	4.7
Total	211	70.3	89	29.7

The Findings in table 4.7 shows a skewed even distribution of having heard of cloud computing across fields of specialization. The study further established that there was a

significant association between field of specialization and having heard of cloud computing (chi=21.68, p<0.001). The study also established that those within the administration were almost three times more likely to have heard of cloud computing than those in maintenance with those in Data and Information Technology field being seven times more likely to have heard of cloud computing as compared to the maintenance counterparts (OR=2.8, 95% CI [1.12, 6.99], P=0.03) and (OR=7.24, 95% CI [2.70, 19.41], p<0.001) respectively. It also found out that those within field and research were more likely to have heard of cloud computing than those in maintenance though there was no significant difference (OR=1.76, 95% CI [0.76, 4.09], p=0.19).

Specialization facilitates division of work into units for efficient performance. According to the classical approach, work can be performed much better if it is divided into components and people are encouraged to specialize by components. Work can be specialized both horizontally and vertically (Anderson, 1988). Vertical specialization in a research organization refers to different kinds of work at different levels, such as project leader, scientist, researcher, field staff, etc. Horizontally, work is divided into departments like genetics, plant pathology, administration, accounts, and ICT.

Specialization enables application of specialized knowledge which betters the quality of work and improves organizational efficiency. At the same time, it can also influence fundamental work attitudes, relationships and communication. This may make coordination difficult and obstruct the functioning of the organization (Lawrence and Lorsch, 1967)

4.5 Infrastructure and cloud computing

One of the objectives was to determine the infrastructure preparedness as a component that would influence the adoption of cloud computing technology in

KEMRI/CDC. To achieve this objective the respondents were requested to respond to various questions under the following sub-themes: Storage location of data/documents for different departments, the speed of internet when using network cable and whether KEMRI/CDC owned servers capable of handling cloud computing.

4.5.1 Storage facility and cloud computing

The study sought to establish the storage location of project departments' data through the respondents. This was important in order to assess the preparedness of KEMRI/CDC in terms of infrastructure that would influence adoption of cloud computing. The respondents were therefore asked to state where they stored their data/ documents and the findings summarized in table 4.8.

Table 4.8: Distribution of data storage locations

Responses	Frequency	Percentage
Network drive	237	79.0
Flash disk	25	8.3
Hard disk	62	20.7
e-mail	9	3.0
Total	300	100.0

Table 4.8 shows that majority of projects stored their data in network drives 237(79%). Others saved data on hard drives 62(20.7%) whereas others saved on flash disks and e-mail 25(8.3%) and 9(3%) respectively. It is important to note that some projects/ departments stored data in more than one location, for example, some saved in Network and hard drives simultaneously.

A study done by AMD indicates that a common discussion between vendors of cloud solutions and organizations using the technology is on what hardware and software is powering the cloud. The results of the study proved overwhelmingly that infrastructure matters. 92% of businesses already using cloud computing stated that the infrastructure – the servers, software and underlying technology - was important in the selection of a cloud solutions provider (AMD 2011).

The results of this study thus show that majority of projects stored their data in network drives 237(79%), a good indication that KEMRI/CDC has servers with capabilities of storing large amounts of data.

4.5.2 Rating KEMRI/CDC internet speed

The study sought to establish how the respondents would rate the speed of internet when using the network cables. This would also be important in assessing the preparedness of KEMRI/CDC in terms of infrastructure that would influence adoption of cloud computing. The respondents were therefore asked to rate the internet speed and the findings summarized in table 4.9.

Table 4.9: Distribution of the respondents' rating of internet speed

Responses	Frequency	Percentage
Excellent	14	4.7
Good	111	37.0
Satisfactory	93	31.0
Poor	76	25.3
Don't know	6	2.0
Total	300	100.0

Table 4.9 shows that 14(4.7%), 111(37%), and 93(31%) of the respondent rated the internet speed as excellent, good and satisfactory respectively. However 76(25.3%) of the respondents said the speed was poor while 6(2%) did not know. Of the six who did not know, two were field workers while 4 were in the maintenance section. The study findings show that almost three quarters (73%) of the respondents believed that the internet speed was above satisfactory.

According to Business Software Alliance (BSA), cloud computing can only achieve its full potential if there is robust, ubiquitous and affordable broadband access (BSA, 2012).

From the findings above, KEMRI/CDC will need to upgrade its internet speeds by purchasing more bandwidth from the service provider to be rated as good and excellent in order for the implementation of cloud computing to be a reality. Slow internet speeds would be a recipe for disaster should cloud computing be implemented.

4.5.3 Capability of servers at KEMRI/CDC to handle cloud computing

The study also sought to know if the respondents thought that the servers at KEMRI/CDC were capable of handling cloud computing. This is also important in assessing the preparedness of KEMRI/CDC in terms of infrastructure that would influence adoption of cloud computing. The respondents were therefore asked if they thought the servers were capable of handling cloud computing the results summarized in table 4.10.

Table 4.10: Distribution of the respondents' thought of capability of servers to handle cloud computing

Responses	Frequency	Percentage
Yes	94	31.3
No	57	19.0
Don't Know	149	49.7
Total	300	100.0

Table 4.10 shows that 94(31.3%) thought that the servers were capable of handling cloud computing, 57(19%) thought that the servers were unable to handle the cloud computing whereas 149(49.7%) did not know whether the servers were able to handle cloud computing. This findings show that almost half of the respondents did not know the capability of servers owned by KEMRI/CDC. The high percentage of respondents not knowing the capabilities of servers is owed to the fact that the I.T infrastructure of KEMRI/CDC is not made available to all staff, but rather to the ICT personnel alone. It is therefore not very easy for staff in other departments to know such details.

Servers are key for storage and IT vendors need to take the lead in the conversation about optimized hardware and software for the cloud. It is time for better education of the market so that customers can make the right infrastructure decisions (AMD 2011). The respondents have little or no information on server capabilities in KEMRI/CDC.

4.5.4 Relationship between field of specialization with knowledge of server capabilities to handle cloud computing

The study also sought to know whether there was any association between respondents' field of specialization with their thought of capabilities of servers to handle cloud computing. This was important to assess as it would help the researcher to further understand the association between this response, that is, thought on capability of servers to handle cloud computing and demographic factors. The findings were summarized in table 4.11 below.

Table 4.11: Distribution of the respondents' field of specialization by knowledge of server capabilities

Field of specialization	Responses					
	YES		NO		DON'T KNOW	
	Freq	%	Freq	%	Freq	%
Administration	34	11.3	9	3.0	29	9.7
Data and it	33	11.0	24	8.0	28	9.3
Field work and research	22	7.3	22	7.3	72	24.0
Maintenance	5	1.7	2	0.7	20	6.7
Total	94	31.3	57	19.0	149	49.7

The Findings in table 4.11 also shows a skewed distribution with those in administration and data/IT fields more likely to think that the servers we capable to handle cloud computing. The study also established that there was an association between field of specialization and opinion over the server capabilities (chi=34.62, $p<0.001$). The study

further established that those in administration and Data/IT were nearly 5 times more likely to think that the organization had servers capable of handling cloud computing compared with their maintenance counterparts (OR=4.76, 95% CI [1.80, 12.58], p=0.002) and (OR=4.57, 95% CI [1.78,11.76], p=0. 002) respectively. This is due to the fact that staffs falling in Data/IT departments have adequate information on the general infrastructure capabilities of KEMRI/CDC. It further established that those in field and research were more likely to think the servers were capable to handle cloud computing though the difference was not significant (OR=1.58, 95% CI [0.62, 4.01], p=0.34). Most of the staff in field and research deal a lot with data collection process and cleaning of the data, which is then stored in network drives, usually file servers. Therefore quite a number of them know the capabilities of servers in KEMRI/CDC.

4.6 Staff knowledge on cloud computing and its adoption

The second objective was to determine how staff knowledge as a component would influence the adoption of cloud computing technology in KEMRI/CDC. To achieve this objective the respondents were requested to respond to various questions under the following sub-themes: knowledge of what cloud computing was, solutions that were suitable for cloud computing and several applications that use the cloud computing technology.

4.6.1 Knowledge of cloud computing

The study sought to establish the respondents' knowledge of cloud computing. This would be important in order to assess the preparedness of respondents to adopt cloud computing. The respondents were therefore asked to state whether they knew the meaning of cloud computing and the findings summarized in table 4.12 below:

Table 4.12: Distribution of respondents' knowledge of the meaning of cloud computing

Responses	Frequency	Percentage
Yes	134	44.7
No	166	55.3
Total	300	100.0

Table 4.12 shows that more respondents did not know the meaning of cloud computing 166(55.3%) though not significantly different from those who knew the meaning of cloud computing (P=0.45). For the IT professionals, this is a well-understood concept and has been an acceptable practice for many years. IT professionals do have a common knowledge of the internet cloud; and there is no single acceptable meaning. Cloud Computing can be broadly defined as several different methods to deliver information or services to customers over a network or internet. Thus, it is a new mechanism to deliver products from a producer to a consumer.

Compared to the findings in the previous section which showed that, 211(70.3%) of respondents had heard of cloud computing while 89(29.7%) had not heard of cloud computing. It can be conclude that having heard of cloud computing doesn't necessarily mean that one knows the meaning of cloud computing.

4.6.2 Staff knowledge on Solutions that would be more suitable for the organization

The study also sought to establish the respondents' thought on which solutions would be more suitable for KEMRI/CDC. The respondents were therefore asked to state the

solutions they thought were more suitable for the organization. These solutions included: Private cloud, Public cloud, Partner cloud and Hybrid cloud; and the results summarized in table 4.13.

Table 4.13: Distribution of respondents' thought on suitable solutions

Responses	Frequency	Percentage
Public	5	1.7
Private	114	38.0
Partner	36	12.0
Hybrid	46	15.3
Don't know	99	33.0
Total	300	100.0

The findings in table 4.13 shows that majority of those who knew would prefer a private solution 114(38%), followed by hybrid and partner solutions at 46(15.3%) and 36(12%) respectively. A large proportion of the respondents did not know which solution to recommend 99(33%). Those who knew the sensitivity of data collected and stored by KEMRI/CDC preferred Private cloud. Very few respondents thought that public cloud was the best option, a view that is insufficient for KEMRI/CDC considering the nature of data it handles.

These results correspond to a study by KPMG (2013) which reported that there seems to be an overwhelming preference for private clouds across workloads, ranging from ERP, F&A migration (70% buyers indicated a preference for private cloud models) for email & collaboration (60%) and custom applications (55%). Such a strong stated preference

can be attributed to the fact that security concerns continue to emerge as the strongest inhibitor to cloud adoption, followed by concerns around integration challenges. Many factors drive the decision over public or private cloud. Industries with the strongest adoption of private clouds are financial services, healthcare and diversified industrials (averaging 45% of respondents), with financial services and healthcare facing heavy regulatory and compliance issues that are exacerbated, though not impossible in the cloud. Organizations' custom-configured applications and infrastructure also contribute to the need for private cloud solutions versus the standardized solutions among public clouds (KMPG, 2013).

4.6.3 Cloud computing Applications that the respondents have interacted with

The study further sought to establish the applications the respondents had interacted with. This was necessary as it would enable the study establish the respondents' knowledge of some applications that use cloud computing technology. The respondents were therefore asked to state the applications they had interacted with and the results summarized in table 4.14.

Table 4.14: Distribution of respondents' interaction with cloud computing applications

Responses	Frequency	Percentage
At lease 1	218	72.7
None	35	11.7
Not sure	31	10.3
Don't know	16	5.3
Total	300	100.0

The findings in table 4.14 shows that majority of the respondents had interacted with at least one application 218(72.7%), it also found the 35(11.7%), 31(10.3%) and 16(5.3%) had not interacted with the applications, were not sure and did not know respectively. Out of the 218 respondents who had interacted with these applications, majority had interacted with google docs 164(75.2%) followed by drop box at 126(57.8) then Icloud, office 365 and Windows Azzure at 21.6%, 16.15% and 13.8% respectively.

In October of 2011, Google announced that 4 million businesses and 40 million people around the globe had bounced over to Google Apps, its suite of Office-like applications that includes Gmail, Google Talk, Calendar, and Docs. This has made Google the most prefered app on the internet considering it comes free and with a series of features including spreadsheets, word processor and presentation slides. Office 365, Microsoft's attempt to offer a cloud-based suite similar to Google Apps, has also drawn complaints—primarily regarding its optimization for Windows at the expense of other platforms (Google, 2010).

Cloud computing, although around for a while, is starting to go mainstream. Email isn't hosted on a machine, but accessed by a browser. And that browser is becoming more mobile and ever-present. Documents are no longer being stored locally and edited by one author, but (thanks to applications like Google docs) accessible anywhere and by anybody. This is causing a fundamental shift in the way we think about and interact with our data (Google, 2010).

4.6.4 Relationship field of specialization with knowledge of the respondents

The study also sought to know whether there was any association between respondents' field of specialization with knowledge of the respondents on cloud computing and its applications. This would help to assess the association between the knowledge of respondents on cloud computing and demographic factors. The findings were summarized in tables 4.15.

Table 4.15: Distribution of the respondents' field of specialization by knowing the meaning of cloud computing

Field of specialization	Responses			
	YES		NO	
	Freq	%	Freq	%
Administration	40	13.3	32	10.7
Data and it	68	22.7	17	5.7
Field work and research	22	7.3	94	31.3
Maintenance	4	1.3	23	7.7
Total	134	44.7	166	55.3

The Findings in table 4.15 shows a skewed distribution with those in administration and data/IT fields more likely to know the meaning of cloud. The study also established that there was an association between field of specialization and knowledge of cloud computing (chi=87.13, p<0.001). The study further established that those in administration and Data/IT were more likely to know the meaning of cloud computing when compared with their maintenance counterparts (OR=7.19, 95% CI [2.26, 22.91], p=0.002) and (OR=23.00, 95%

CI [7.02, 75.40], p=0. 001) respectively. It further established that those in field and research were more likely to know the meaning of cloud computing though the difference was not significant (OR=1.35, 95% CI [0.42, 4.29], p=0.62).

Specialization enables application of specialized knowledge which betters the quality of work and improves organizational efficiency. At the same time, it can also influence fundamental work attitudes, relationships and communication (Lawrence and Lorsch, 1967). It is therefore clear that staff in IT and Data departments knew the meaning of cloud computing since it falls in their area of specialization and being a new technology in the market, most of the respondents in these departments are seen to be keeping abreast of new technologies.

4.7 Staff skills on cloud computing

The third objective was to determine how staff skills as a component of preparedness would influence the adoption of cloud computing technology in KEMRI/CDC. The respondents were asked to respond to two main questions in order to achieve this objective.

4.7.1 Skills on operation of any of the applications using cloud technology

The study sought to establish whether the respondents had operated any of the applications using cloud computing technology. This would be important in assessing the skills of the staff with regards to operating the applications. The respondents were therefore asked to state whether they had operated any of the applications and the results summarized in table 4.16 below.

Table 4.16: Distribution of respondents' having operated any of the applications that use cloud computing

Responses	Frequency	Percentage
Yes	187	62.3
No	87	29.0
Don't Know	26	8.7
Total	300	100.0

The findings in table 4.16 shows that most respondents 187(62.3%), had used the applications and that 87(29%) had not interacted with these applications and that only 26(8.7%) did not know whether they had used those applications or not.

Compared to the results in the previous section, a total of 218 respondents had interacted with the applications listed; and of these, 187 could effectively operate the applications.

These results contradict with a study done by AMD, which stated that 43 % of public sector respondents did not feel they had the skills in place to support cloud versus only 23 % in the private sector (AMD 2011). It also made it clear that one key hurdle that still remains for the public sector to fully embrace cloud computing is having the necessary IT skills in-house to support the deployment of cloud solutions.

4.7.2 Respondents having an experience with windows 8 Operating System

The study also sought to find out if the staff had experience using windows 8 Operating System. This was important in assessing the skills of the staff with regards to the

operating systems experience. The respondents were therefore asked to state whether they had experience using windows 8 Operating system and the findings summarized below.

Table 4.17: Distribution of respondents' having used windows 8 Operating System

Responses	Frequency	Percentage
Yes	150	50.0
No	143	47.7
Don't know	7	2.3
Total	300	100.0

Table 4.17 shows that half of the respondents had experience using windows 8 operating system 150(50%) whereas 143(47.3%) and 7(2.3%) had not used it or didn't know if they had used it respectively. This shows that a big percentage of the respondents have used and continue to use cloud computing without actually knowing that they are.

These results concur with those of a report which showed that Windows 8 is slowly but steadily increasing its share of usage worldwide. In May 2013, according to the NetMarketShare statistics, Windows 8 usage increased from 3.8 % to 4.3 %. That pace has remained about the same since February 2013, the first full month after Microsoft's discounted upgrade offer ended. Since then, NetMarketShare says Windows 8 usage has increased by an average of about 0.5 % per month (Bott, 2013).

4.7.3 Relationship between field of specialization with skills of the respondents

The study also sought to know whether there was any association between respondents' age and field of specialization with ability to operate applications that use cloud computing technology and windows 8 operating system. This would help to assess the

association between the respondents' skills on cloud computing and demographic factors. The findings were summarized in tables 4.18.

Table 4.18: Distribution of the respondents' field of specialization by knowing how to operate the applications

Field of specialization	Responses					
	YES		NO		DON'T KNOW	
	Freq	%	Freq	%	Freq	%age
Administration	32	10.7	26	8.7	14	4.7
Data and it	72	24.0	12	4.0	1	0.3
Field work and research	71	23.7	39	13.0	6	2.0
Maintenance	12	4.0	10	3.3	5	1.7
Total	134	62.3	87	29.0	26	8.7

The Findings in table 4.18 shows a distribution where those in data/IT field are more likely to know how to operate the applications 24%. The study also established that there was an association between field of specialization and knowing how to operate applications (chi=40.94, $p<0.001$). The study further established that those in Data/IT were more likely to know how to operate the applications when compared with their maintenance counterparts (OR=7.63, 95% CI [2.99, 19.48], $p<0.001$). It further established that those in field and research were more likely to know the meaning of cloud computing though the difference was marginally significant while those in administration were less likely to know how to operate the applications though the difference was insignificant (OR=2.23, 95% CI [0.99, 5.03], p=0.05) and (OR=0.98, 95% CI [0.42, 2.29], p=0.96) respectively.

According to Zhu and Kraemer (2005) a firm with a high level of organizational IT capability tends to enjoy greater readiness to use cloud computing in its business processes.

The findings above concur with literature that states that across the IT industry, CIOs, technology vendors, and consultants agree that there is a serious shortage of cloud computing skills that threatens to hamper adoption. Whether it's software engineers who know how to develop applications for the cloud, resource planners who can estimate an enterprise's need for computing capacity, architects who can integrate services from different cloud vendors, or administrators who understand how to configure and support cloud-based services, a wide range of cloud-related skills are in great demand, and companies can't leverage the benefits of cloud computing without them (MicroAssist, 2013).

4.8 Staff attitude on cloud computing

The last objective was to determine how staff attitude as a component of preparedness would influence the adoption of cloud computing technology in KEMRI/CDC. The respondents were asked to respond to main questions in order to achieve this objective.

4.8.1 Thought on KEMRI/CDC's preparedness to adopt cloud computing

The study sought to establish whether the respondents thought KEMRI/CDC was prepared to adopt cloud computing technology. This was important as it assisted in assessing the attitude of the staff with regards to preparedness to adopt cloud computing. The respondents were therefore asked whether they thought the organization was prepared and the findings summarized in table 4.19.

Table 4.19: Distribution of respondents' thought on organization preparedness to adopt cloud computing

Responses	Frequency	Percentage
Yes	109	36.33
No	57	19
Don't Know	134	44.67
Total	300	100.0

The findings in table 4.19 shows that many people did not know whether the organization was prepared to take up cloud computing 134(44.7%) with 109(36.3%) stating that they thought the organization was prepared.

These responses show that a large percentage of respondents do not know the capabilities of KEMRI/CDC when it comes to adoption of cloud computing. This corresponds to the earlier results which showed that 31% of the respondents thought that KEMRI/CDC had the capabilities of handling cloud computing. It is clear that the respondents do not know that when they store data in network drives, which a majority selected, then it is stored on file servers. This information is lacking to the respondents across the different departments. The findings show that staff should be empowered with information especially through in-house trainings.

4.8.2 Respondents preparedness to adopt cloud computing

The study sought to establish whether the respondents were prepared to adopt cloud computing technology. This was important as it assisted in assessing the attitude of the staff

with regards to personal preparedness to adopt cloud computing. The respondents were therefore asked whether they were prepared and the findings summarized in table 4.20

Table 4.20: Distribution of respondents' preparedness to adopt cloud computing

Responses	Frequency	Percentage
Yes	173	57.67
No	61	20.33
Don't Know	66	22
Total	300	100.0

The findings in table 4.20 shows that most respondents were actually prepared to adopt cloud computing 173(57.7%) while 61(20.2 %) and 66(22%) were not prepared or did not know if they were prepared respectively.

These findings concur with those of a study done by AMD that stated that despite the increased trust in cloud-based solutions among businesses, there are still a number of significant barriers to adoption for those organizations looking to implement the technology. 23 % of respondents stated that worries about the reliability of technology was the single biggest inhibitor in making a move to the cloud suggesting that many companies will be waiting for the technology to mature before testing out the cloud. This number drops to 15 % in Europe and 18 % in Asia where they are most concerned with "fear of the unknown" (AMD, 2011).

4.8.3 Respondents thought on adoption of cloud computing and their job security

The study also sought to know whether the respondents thought adopting cloud computing would affect their job security. This was important to evaluate as it would assist in assessing the attitude of the staff with regards to job security. The respondents were therefore asked whether they thought adopting cloud technology would affect their job security, this was summarized in table 4.21.

Table 4.21: Distribution of respondents' thought on their job security

Responses	Frequency	Percentage
Yes	76	25.33
No	144	48
Don't Know	80	26.67
Total	300	100.0

Table 4.21 shows that many respondents thought that adoption of cloud computing would not affect their job security 144(48%) while 76(25.3% thought it would affect their jobs whereas 80(26.7%) did not know if adoption of cloud computing would affect their job security.

Those who thought cloud computing would affect their job security probably did not know what would be entailed in cloud computing. Adoption of cloud computing is meant to make work easier and more accessible to the users, and not threaten their job security. It is meant to be an enabler and not an inhibitor.

4.8.4 Impact of training on understanding of the cloud computing concept

The study also sought to establish whether the respondents thought training would assist in understanding the cloud computing concept. The respondents were asked whether they thought training would help in understanding the cloud computing concept and the findings summarized in table 4.22.

Table 4.22: Distribution of thought that training would assist in understanding cloud computing concept

Responses	Frequency	Percentage
Yes	280	93.33
No	8	2.67
Don't Know	12	4
Total	300	100.0

The findings as in table 4.22 shows that majority of respondents thought that training would indeed assist in understanding this concept 280(93.3%). This large number clearly depicts the need for training in the advent of a new technology at the work place.

Business owners everywhere, as well as consumers, are hearing all about cloud computing and what a great technology it is and how it will improve efficiency. However, in spite of all the hype about cloud computing, education is still needed to help promote a complete understanding of this great new technology.

Nearly 40% of respondents expect to increase their training investment to support a cloud computing expansion in their organization (Yahoo, 2013).

4.8.5 Should KEMRI CDC Invest in cloud computing?

The study further sought to establish whether the respondents thought KEMRI/CDC should invest in cloud computing. The respondents were asked whether they thought KEMRI/CDC should invest in cloud computing. The findings summarized in table 4.23

Table 4.23: Distribution of thought that the organization should invest in cloud computing

Responses	Frequency	Percentage
Yes	188	62.67
No	31	10.33
Don't Know	81	27
Total	300	100.0

The findings as in table 4.23 shows that majority of respondents thought that the organization should invest in cloud computing 188(62.7%) while 31(10.3%) thought KEMRI/CDC should not with 81(27%) not knowing whether the organization should invest in cloud computing.

According to Mata et al. (1995), organizational IT capability is recognized as having three subsets: infrastructure, IT personnel, and IT-related knowledge (Mata et al. 1995). Thus, capability is an integrative concept that reflects a firm's knowledge as well as physical assets.

4.8.6 Relationship between age with personal preparedness to adopt cloud computing

The study further looked into the association between respondents' age with their attitude towards adoption of cloud computing. This was important to assess as it would help the researchers understand the association between the staff attitude and demographic factors.

Table 4.24: Distribution of age by personal preparedness to adopt cloud computing

Age Category	Responses					
	YES		NO		DON'T KNOW	
	Freq	%	Freq	%	Freq	%
18-25	46	15.3	5	1.7	13	4.3
26-35	75	25.0	29	9.7	29	9.7
36-40	39	13.0	19	6.3	12	4.0
>= 41	13	4.3	8	2.7	12	4.0
Totals	173	57.7	61	20.3	66	22.0

The study also established that the respondents in younger age brackets, and those in data and IT fields were more likely to be prepared to adopt cloud computing. However, years of service were not a significant determinant. These findings were summarized in table 4.24.

The study looked into the association between age and personal preparedness to adopt cloud computing as in table 4.24, it was established that there was a significant association (chi=15.09, p=0.02). It also showed that those between 26 and 35 years and 35

to 40 were not significantly different compared to those between 18 and 25. It however found that those above 40 were significantly less likely prepared to adopt cloud computing (OR=0.28, 95% CI [0.12, 0.66], p=0.003).

These results concur with those of a study that showed that most respondents (85.1%) were in the 21–30 age group and were conversant with cloud computing applications like Google Apps (Sang and Sung, 2012).

These results concur with studies from Germany which show in their analyses that the computer skills of younger employees are better than those of older workers. De Koning and Gelderblom (2006) additionally exhibit that the probability of using complicated ICT applications at work is lower among workers above 50 years. (Borghans and ter Weel 2002) and (de Koning and Gelderblom 2006)

4.8.7 Relationship between field of specialization with personal preparedness to adopt cloud computing

The study further looked into the association between respondents' field of specialization with their attitude towards adoption of cloud computing. This was important to assess as it would help the researchers understand the association between the staff attitude and their field of specialization.

Table 4.25: Distribution of field of study by personal preparedness to adopt cloud computing

Field of specialization	Responses					
	YES		NO		DON'T KNOW	
	Freq	%	Freq	%	Freq	%
Administration	45	15.0	11	3.7	16	5.3
Data and it	70	23.3	6	2.0	9	3.0
Field work and research	50	16.7	32	10.7	34	11.3
Maintenance	8	2.7	12	4.0	7	2.3
Total	173	57.7	61	20.3	66	22.0

The findings in table 4.25 summarized the distribution of the respondents' field of study field of study. The study established that there was an association between field of specialization and personal preparedness to adopt cloud computing (chi=44.25, p<0.001). The study further established that those in administration and Data/IT were more likely to be prepared to adopt cloud computing compared to those in maintenance (OR=2.44, 95% CI [1.09, 5.44], p=0.03) and (OR=7.04, 95% CI [2.98, 16.65], p<0. 001) respectively. It further established that those in field and research were more likely to be prepared to adopt cloud computing though the difference was not significant (OR=1.25, 95% CI [0.60, 2.59], p=0.55).

A study by AMD reported that 57% of public sector organizations globally that have shifted to a cloud deployment model had the necessary IT skills in house to make that

change. By contrast, only 25% of organizations currently investigating cloud computing in the public sector feel that they are in possession of those skills. That is a key area of concern where better education must be provided to ensure those who do deploy cloud are comfortable managing their IT and can reap the most value from it (AMD, 2011).

Overall, there is healthy uptake of cloud solutions. 37 % of businesses globally are deploying cloud to either remotely host applications or host data (or both), with North America and Asia being most advanced in their implementation of cloud solutions. Globally, the majority of organizations are at the stage of „investigating the technology, " with only a very small number (3 %) having rejected the move to cloud, outright. The adoption and level of engagement around cloud points to the fact that organizations needs and IT environments across the world are as unique as ever, leading to a staggered uptake of cloud models. With such a significant percentage of organizations evaluating cloud globally, this suggests we can expect an even greater wave of cloud deployments in the year 2013 as these organizations move from investigation to implementation (AMD, 2011).

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter discusses in details a summary of the findings, conclusions, recommendations, recommendations for further studies and contribution to the body of knowledge.

5.2. Summary of findings

The objectives of this study were to establish how infrastructure as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC, to assess how staff knowledge as a component of preparedness would influence the adoption of cloud computing in KEMRI/CDC, to examine how staff skills as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC and finally to examine how staff attitude as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC.

For the first objective which was to establish how infrastructure as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC, results showed that: majority of projects stored their data in network drives 237(79%), a good indication that KEMRI/CDC has servers with capabilities of storing large amounts of data. It was also clear that almost three quarters (73%) of the respondents believed that the internet speed was above satisfactory and finally almost half of the respondents did not know the capability of servers owned by KEMRI/CDC.

The second objective which was to establish how staff knowledge as a component of preparedness towards adopting cloud computing yielded results showing that knowledge of cloud computing was significantly associated with personal preparedness to adopting cloud computing (chi=92.32, p<0.001) and that those who knew cloud computing were nearly 14 times more likely to be prepared to adopt cloud computing (OR=14.52, 95% CI [7.91, 26.64], p<0.001). The results of this study also showed a skewed distribution with those in administration and data/IT fields more likely to know the meaning of cloud computing. The study also established that there was an association between field of specialization and knowledge of cloud computing (chi=87.13, p<0.001). Majority of those in higher age categories did not know the meaning of cloud computing. The study established that there was a significant association between age and knowledge of cloud computing (chi=8.22, p=0.04). The younger age group were more conversant with the concept of cloud computing and knowledge on the technology.

As for the third objective which was to examine how staff skills as a component of preparedness will influence adoption of cloud computing technology in KEMRI/CDC, the findings established that there was an association between field of specialization and knowing how to operate applications (chi=40.94, p<0.001). The study further established that those in Data/IT were more likely to know how to operate the applications when compared with their maintenance counterparts (OR=7.63, 95% CI [2.99, 19.48], p<0.001). The study findings showed that there was association between knowing how to operate applications and whether the respondents thought the organization was prepared to adopt cloud computing (chi=27.21, p<0.001) and that those who knew how to operate the applications were more likely to think the organization was prepared to adopt cloud

computing(OR=3.24, 95% CI [1.96, 5.36], p<0.001). It also showed that having experience in using windows 8 was significantly associated with the thought that the organization was prepared to adopt cloud computing (Exact chi=22.76, p<0.001) and that those who had experience in using windows 8 were more likely to recommend the adoption of cloud computing by the organization (OR=2.70, 95% CI [1.74, 4.20], p<0.001). In summary, those who knew how to operate the applications that use the cloud computing technology and those who had experience using windows 8 were more prepared and more likely to embrace adoption of cloud computing and more likely to recommend the organization's investment into cloud computing.

Lastly, the fourth objective which was to examine how staff attitude as a component of preparedness will influence adoption of cloud computing technology in KEMRI/CDC got the following results: The study found that there was a significant association between age and the thought that KEMRI/CDC was prepared to adopt cloud computing (chi=13.34, p=0.04). The study further established that those in administration and Data/IT were more likely to think that the organization was prepared compared to their maintenance counterparts (OR=3.57, 95% CI [1.80, 11.14], p=0.001) and (OR=4.57, 95% CI [1.78, 11.76], p=0.002) respectively. It also showed that field of specialization was significantly associated with the thought that cloud computing would affect job security (chi=26.46, p<0.001). With these findings the study drew a conclusion that the respondents in administration and Data/IT were more prepared to adopt cloud computing than the respondents in maintenance with those in maintenance more likely to think adoption of cloud computing would affect their job security. Years of service were not significant in many cases.

5.3. Conclusions

In relation to the first objective that was to establish how infrastructure as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC, it can be concluded that KEMRI/CDC has the capability of adopting cloud computing owing to the fact that it has adequate servers for data storage and that it has satisfactory internet speed which can be upgraded to even perform better. It was also clear that a large percentage of respondents are using cloud computing without actually knowing they are doing so.

As far as the second objective that was to establish how staff knowledge as a component of preparedness will influence adoption of cloud computing, it can be concluded that staff working in the data/I.T departments were more aware of the existence of cloud computing technology and could comfortably define it, unlike their counterparts in the maintenance department.

It can be concluded from the third objective that respondents in the lower age category were more skillful and had experience in operating the applications that are directly associated with cloud computing. In addition, there was a significant association between those who knew how to operate these applications and the thought that KEMRI/CDC should consider investing in into cloud computing.

Lastly, from the fourth objective which was to examine how staff attitude as a component of preparedness will influence adoption of cloud computing technology in KEMRI/CDC, it can be concluded that the younger respondents and those in administration and Data/IT departments were more prepared to adopt cloud computing compared to the

older respondents and those in maintenance; with those in maintenance more likely to think that adoption of cloud computing would affect their job security.

5.4. Recommendations

Results and conclusions of this study show a great association between age and knowledge of cloud computing technology with a majority of the younger age group showing expertise and experience in using applications associated with cloud computing technology. I therefore recommend awareness training to the older age groups within KEMRI/CDC and introduction of cloud based applications within the organization to enable all staff an equal opportunity to learn this concept, a step that will make more numbers appreciate and recommend the adoption of cloud computing. Secondly, it was clear that consideration for cloud computing adoption was significantly associated with the departments from which the respondents came. Those from DATA/IT seemed to be ready to adopt cloud computing for their everyday duties at work unlike those from maintenance who thought the adoption of cloud computing would affect their job security. I recommend basic trainings on ICT processes to this group of staff and regular awareness training on new technologies in the market. Thirdly, it was also noted that a majority feel that the internet speeds were generally satisfactory. I recommend that KEMRI/CDC works out a plan for upgrading the internet bandwidth from the service provider in order to efficiently handle cloud computing.

5.5. Suggestions for further studies

Having reviewed the finding of the study, the following areas may need further exploration. First, there is need to look at the factors that would influence adoption of cloud computing from management point of view. Secondly, being a technology that has emerged

recently there are few academic researches which have been done in the area of cloud computing research in general (Armbrust et al., 2009, Wang and Laszewski, 2008); there is a need for more research to be done on the adoption trends and preparations to be considered when thinking of cloud computing implementation in an organization.

5.6. Contribution to the body of knowledge

Objective	**Contribution to body of knowledge**
To establish how infrastructure as a component of preparedness would influence adoption of cloud computing technology in KEMRI/CDC	It was discovered that KEMRI/CDC has adequate servers and thus adoption of cloud computing technology is feasible. Internet speeds in KEMRI/CDC was thought of to be satisfactory, although an upgrade would be recommended.
To assess how staff knowledge as a component of preparedness would influence the adoption of cloud computing in KEMRI/CDC.	Knowledge of cloud computing technology was associated with field of specialization of the respondents and was also significantly associated with age. Years of service had no significance on knowledge of cloud computing technology.
To examine how staff skills as a component of preparedness will influence adoption of	Majority of staff who were skilled in cloud computing technology belonged to the

cloud computing technology in KEMRI/CDC.	youngest age group in the study, i.e. between 18 to 25; and also to I.T related professions.
To examine how staff attitude as a component of preparedness will influence adoption of cloud computing technology in KEMRI/CDC.	Majority of respondents felt that training will help them better understand cloud computing technology and were ready to take it up for their day to day duties. However, a few felt that it would affect their job security.

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APPENDICES

Appendix I: Letter of Transmittal

Nivian Anyango Ogogo,
KEMRI/CDC,
ICT Department,
P.O Box 1578,
Kisumu.

Dear Respondent,

RE: ANALYSIS OF PREPAREDNESS TOWARDS ADOPTING CLOUD COMPUTING TECHNOLOGY: A CASE OF KENYA MEDICAL RESEARCH INSTITUTE/CENTRES FOR DISEASE CONTROL AT THE KISIAN STATION, KISUMU COUNTY, KENYA

I am a student of the University of Nairobi, pursuing a Masters of Arts Degree in Project Planning and Management. I am currently in the process of undertaking a research on the preparedness of KEMRI/CDC in adopting cloud computing technology.

The study will involve collecting data from the KEMRI/CDC staff. The purpose of this letter therefore is to request your participation by either filling in a questionnaire or taking part in an interview as will be determined.

I look forward to your cooperation.

Yours faithfully,

Nivian Anyango Ogogo

Appendix II: Staff Questionnaire

6355137662

STAFF QUESTIONNAIRE

BACKGROUND INFORMATION

Bubble as appropriate and any writing should be legible and in the space provided

Department

Age O 18-25 O 26-35 O 36-40 O 41 and above

Profession

Years of service

SECTION A: THE CONCEPT OF CLOUD COMPUTING

1. Do you have a gmail/yahoomail/Hotmail/facebook account? O Yes O No
2. Are you able to access yourmails from any location with internet connectivity? O Yes O No O Dont know
3. Have you ever heard about cloud computing? O Yes O No
4. Can you define cloud computing? O Yes O No

SECTION B : INFRASTRUCTURE PREPAREDNESS

5. Where does your project store its data/documents? O Network drive O Flash disk O Hard disk O email
6. How would you rate KEMRI/CDC internet speed when using network cable? O Excellent O Good O Satisfactory O Poor O Dont know
7. Do you think KEMRI/CDC owns servers capable of handling cloud computing? O Yes O No O Dont know

SECTION C: STAFF KNOWLEDGE

9. Do you know the meaning of cloud computing? O Yes O No
10. Which solution do you think would be more suitable for KEMRI/CDC ?
    - O Public cloud (owned and managed by an unrelated business)
    - O Private cloud (owned and managed internally)
    - O Partner cloud (owned and managed by a trusted partner)
    - O Hybrid cloud (a combination of Public and Private clouds)
    - O Dont know
11. Which of the following applications have you interacted with before? ***(Bubble all Relevant options)***

    O Dropbox O Windows Azzure O Office 365 O Icloud O Google docs O None of the above

    O Dont know O Not sure

File number

0053137661

SECTION D: STAFF SKILLS

12. Can you effectively Operate any of the applications listed in ***Question 11*** above? O Yes O No O Dont know

13. Do you have an experience using windows 8 operating system? O Yes O No O Dont know
(if yes , do question 14)

14. Do you have a SkyDrive account? O Yes O No O Dont know

SECTION E: STAFF ATTITUDE

15. Do you think KEMRI/CDC is prepared to adopt cloud computing? O Yes O No O Dont know

16. Are you prepared to take up cloud computing for your day to day duties? O Yes O No O Dont know

17. Do you think a doption of cloud computing will affect your job security? O Yes O No O Dont know

18. Do you think training will assist in understanding the concept of cloud computing? O Yes O No O Dont know

19. Do you think KEMRI/CDC should invest in cloud computing? O Yes O No O Dont know

Thank you for your participation

Appendix III: Letter from NCST

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349, 254-020-2673550
Mobile: 0713 788 787 , 0735 404 245
Fax: 254-020-2213215
When replying please quote
secretary@ncst.go.ke

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/13/013/44**

Date: **22nd May 2013**

Nivian Anyango Ogogo
University of Nairobi
P.O Box 30197-00100
Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application dated **6th May, 2013** for authority to carry out research on ***"Analysis of preparedness towards adopting cloud computing technology: A case of Kenya Medical Research Institute/Centre for Disease Control at the Kisian station, Kisumu County, Kenya."*** I am pleased to inform you that you have been authorized to undertake research in **Kisumu District** for a period ending **31st August, 2013.**

You are advised to report to **the Chief Executive Officer, Kenya Medical Research Institute/Centre for Disease Control** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:
The Chief Executive Officer
Kenya Medical Research Institute/CDC

Appendix IV: Permit

PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
Nivian Anyango Ogogo
of (Address) University of Nairobi
P.O Box 30197-00100, Nairobi.
has been permitted to conduct research in
Kisumu Location
Nyanza Province
on the topic: Analysis of preparedness toward adopting cloud computing technology: A case of Kenya Medical Research Institute/Cent e for Disease Control at the Kisian station, Kisumu County, Kenya.
for a period ending: 31st August, 2013.

PAGE 3

Research Permit No. NCST/RCD/13/013/44
Date of issue 22nd May, 2013
Fee received KSH. 1000

.....
Applicant's Signature

.....
Secretary
National Council for Science &Technology